FISHERY DATA SERIES NO. 119

WARD CREEK STEELHEAD CREEL SURVEY, KETCHIKAN, ALASKA, 1988[1]

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ABSTRACT

From 29 February through 19 June 1988, anglers expended an estimated 3,638 angler-hours fishing for steelhead *Oncorhynchus mykiss*. The 95% confidence intervals for this estimate were from 2,378 to 4,898. The estimate for the number of steelhead caught and kept was 359 with 95% confidence intervals from 193 to 525, while the estimated number of steelhead caught and released was 971 with 95% confidence intervals from 45 to 2,069. Nine per cent of the steelhead caught and kept were hatchery fish. Biweekly estimates of effort and catch were also computed. Distribution of fishing effort, standard age-weight-length data, and the distribution of spawning steelhead were also recorded.

KEY WORDS: Southeast Alaska, Ketchikan, steelhead, *Oncorhynchus mykiss*, creel survey, angler interviews, estimated effort, estimated harvest, distribution of effort, distribution of spawning, hatchery contributions.

INTRODUCTION

The Alaska Department of Fish and Game, Sport Fish Division, in cooperation with the Division of Fisheries Rehabilitation, Enhancement and Development (FRED), has been enhancing the Ward Creek steelhead *Oncorhynchus mykiss* run for the past seven years with hatchery smolts reared either at the Deer Mountain or Klawock Lake hatcheries. Actual plants of steelhead smolts have ranged from as few as 1,200 in earlier years up to present plants of 20,000 to 30,000 smolts on an annual basis.

The perceived results of the yearly plants, based on voluntary information provided by local anglers, have varied with levels of enhancement and the intensity of the sport fishery in Ward Creek. During recent years, annual plants in this system have averaged around 30,000 steelhead which has produced an ever increasing number of adult returns to this system. Angler interest in this stream has increased ten fold over past years, and due to its easy accessibility on the Ketchikan road system, fishing pressure and harvest have also increased. Thus, the combination of the Department's enhancement work and increased angler pressure mandates that the Division of Sport Fish undertake a creel survey program to properly evaluate the effects on wild stocks and fishing success from enhancing the steelhead population in this stream.

Presently, the Ketchikan Area Management biologist has very little precise information on Ward Creek steelhead stocks other than public input. Enhancement of this system has been on-going since 1981 with only spot checks made of the actual fishery to determine the effects of this program. Information gained from a creel survey project on Ward Creek will enable better management decisions to be made in the future concerning enhancement levels, bag limits, gear restrictions, area restrictions, and habitat degradation concerns.

The specific objectives of the project were to:

1. Estimate the recreational fishing effort, the number of steelhead caught and kept, the number of steelhead caught and released, and the catch per unit of effort (CPUE) of hatchery-reared and wild steelhead in Ward Creek from 15 March to 15 June 1988.

2. Estimate the length frequency distribution and the age composition of the steelhead caught in Ward Creek from 15 March to 15 June 1988.

METHODS

The study period for this program was 29 February 1988 through 19 June 1988. Biweekly strata were established during this period. Within each strata all days were divided into two substrata, weekdays and weekends, with all legal holidays identified within the weekend stratum. In addition, each day was subdivided into early day and late day substrata.

Each identified access location on Ward Creek was sampled randomly as determined by random number generation.

Actual creel survey interviews were conducted by a permanent/seasonal Fisheries Technician III who was stationed on any assigned day at a pre-assigned access location. During the assigned sampling period all anglers were interviewed as they completed their fishing activities. All interviewed anglers were questioned to determine how long they had been fishing and how many fish by species they had caught and kept, and caught and released. Anglers were also asked whether they were Alaskan residents or not, number of days fished, and type of gear used. Standard age-weight-length (AWL) data were collected from steelhead kept by interviewed anglers.

Heads from adipose clipped steelhead were sent to the Division of Fisheries Rehabilitation, Enhancement, and Development's (FRED) Tag Lab in Juneau where any tags present were removed and decoded. The tag recovery information from each head was then entered into the Tag Lab's data base. In conjunction with FRED personnel, sport sampling effort and estimated catch were also entered into a related data base so that the hatchery contribution estimate could be generated directly.

Study Design

An on-site direct expansion completed-trip creel survey was used to estimate characteristics of the Ward Creek steelhead fishery. For the on-site survey, individual anglers were intercepted at discrete access locations during a specified period of time. Note that this type of survey can only be used in fisheries which have finite, discrete, and "sampleable" access locations. Counts of fish harvested by all anglers interviewed during the specified time period were expanded upwards for the periods of time for which no samples were made. Similarly, effort in angler-hours as measured from the same interviews, were expanded to obtain the effort estimate.

In the Ward Creek area, there are several access locations to the steelhead fishery. In order to more efficiently sample the fishery, the stream was stratified into five areas related to the major access locations (Figure 1). The five strata were:

area 1: from the intertidal area at Ward Cove upstream to the canyon area at the outlet of Ward Lake,

area 2: from the canyon area upstream to the Ward Creek Road bridge above Ward Lake,

area 3: from the Ward Creek Road bridge upstream to the first falls above the swinging bridge,

area 4: from the falls above the swinging bridge upstream to the Last Chance camping area, and

area 5: from the Last Chance camping area upstream to the dam at Connell Lake.

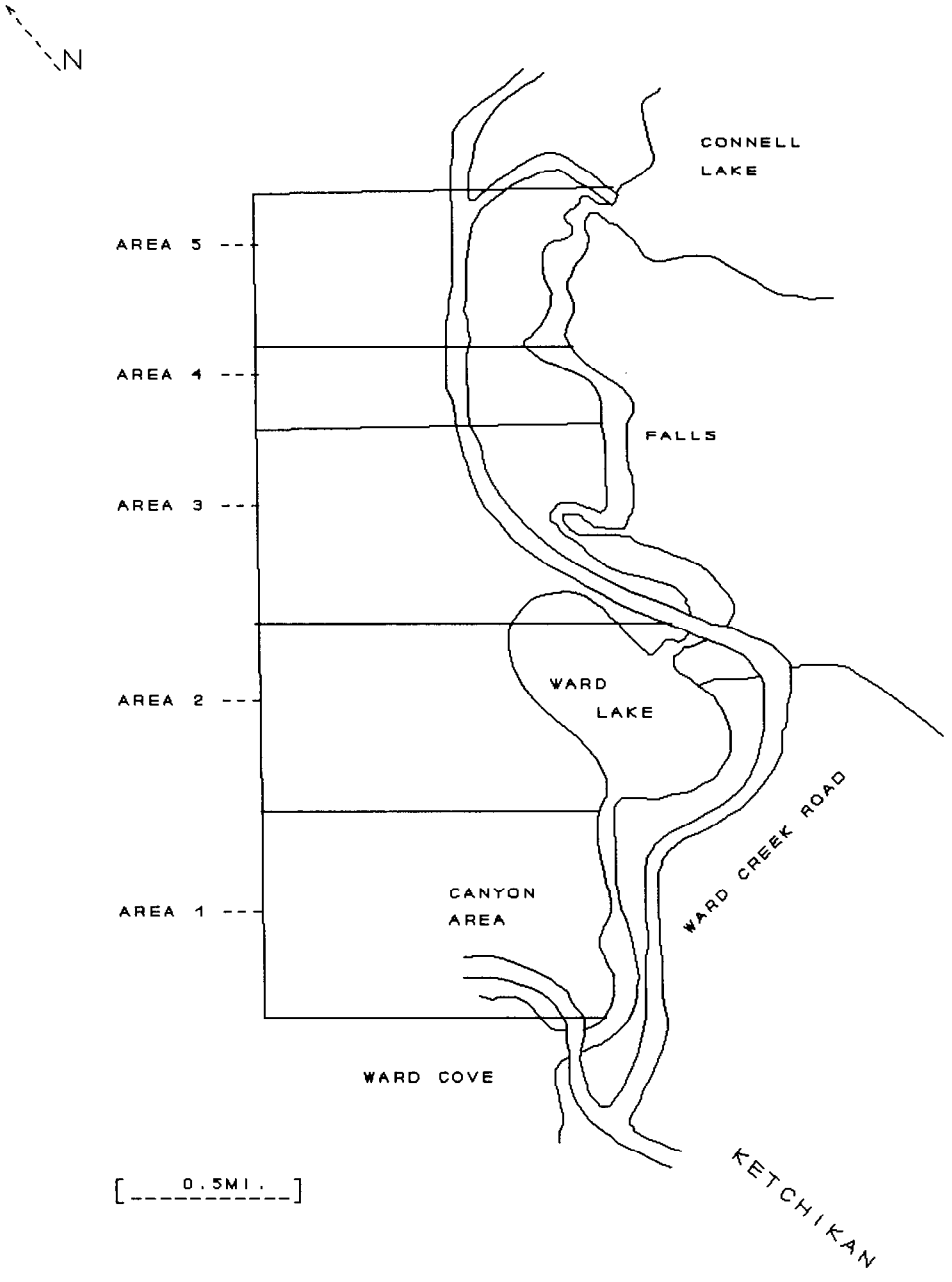

Figure 1. Creel census sampling areas on Ward Creek, 1988.

The 1988 season was subdivided into "seasonal" time strata. The seasonal time strata were as follows:

DATES	STANDARDIZED BIWEEKLY STRATA
29 Feb 88 - 13 Mar 88	5
14 Mar 88 - 27 Mar 88	6
28 Mar 88 - 10 Apr 88	7
11 Apr 88 - 24 Apr 88	8
25 Apr 88 - 08 May 88	9
09 May 88 - 22 May 88	10
23 May 88 - 05 Jun 88	11
06 Jun 88 - 19 Jun 88	12

The type of fishing day was an additional level of stratification. The types of day were weekday and weekend-holiday. Samples were allocated according to the following scheme:

1. Within any week (i.e., Monday-Sunday), all weekend-holidays were selected for sampling.

2. Then two contiguous weekdays were randomly selected for "non-sampling" (in order to assure 2 days off for staff).

3. For all seasonal strata, either an early or a late time-of-day stratum was selected. During each selected time-of-day stratum 2 (of the 2 possible) sampling periods were selected.

4. Then, selected samples were allocated to area strata at random so that approximately one-half of the available samples went to the upstream stratum (areas 3-5) and one-half to the downstream stratum (areas 1 and 2).

5. Finally, within an upstream or downstream stratum, one of the possible areas was selected at random.

Additionally, logistical constraints (i.e. time to travel from one area to another) played an important part in the sample allocation process.

Adipose-clipped (hatchery) steelhead encountered in the sport harvest were measured (mid-eye to fork of tail) and their heads were retained. A cinch strap with a unique number was inserted through the jaw of each fish. Heads and relevant recovery information were forwarded to the ADF&G Tag Lab for tag removal and decoding. Heads were classified as random (randomly sampled during scheduled creel surveys) or select (turned in voluntarily).

Data Collection

Data collected from each completed trip angler interviewed during each sampling period included hours fished, and number of fish kept and/or released by species. If it was not possible to interview all completed trip anglers, the total number of completed trip anglers was recorded. All on-site interview data were recorded on Marine Interview mark-sense forms (version 1.0).

In addition to interviewing individual anglers, the creel technician also sampled catches as time allowed. Catches of steelhead checked for adipose clips were recorded as "sampled", while catches not checked were recorded as "not sampled." Heads from adipose clipped fish were collected and identified with a uniquely numbered cinch strap. Detailed information concerning the clipped fish was recorded on Coded Wire Tag Recovery Sampling Forms. Scales from steelhead were taken and mounted on gum cards. Lengths in millimeters (mid-eye to fork of tail) of these steelhead were recorded on Alternate Age Weight Length (AWL) mark-sense forms to which the gum cards were then taped.

Data Reduction

The creel technician checked her data and turned it in to the Ketchikan office on a weekly basis. The mark-sense data forms were checked again, grouped into batches, and sent to Research and Technical Services (RTS) in Anchorage for op-scan reading. After op-scan reading was completed, the data were returned to Ketchikan for final editing and analysis. Data were initially edited in Microsoft WORD on a microcomputer and the data were read into a SAS data set using SAS-PC (SAS 1985). After final checking of the SAS data set, the data were analyzed using SAS-PC in accordance with the methods outlined below. Once data were finalized, the data files were archived at RTS in Anchorage and in the Ketchikan office.

Heads from adipose clipped steelhead were sent to the FRED Tag Lab in Juneau where any tags present were removed and decoded. The tag recovery information from each head was entered into the tag lab data base. In conjunction with FRED division personnel, sport sampling effort and estimated catch were also entered into a related data base so that a hatchery contribution estimate could be generated directly. Steelhead scales were pressed onto acetates and read by personnel from the Sport Fish Division in Ketchikan. Ages were recorded onto the matching Alternate AWL mark sense forms and the forms were returned to Sport Fish RTS in Anchorage for op-scan reading, editing, and data analysis using procedures detailed above.

Data Analysis

The following equations were used for estimation of harvest and effort for the direct expansion completed-trip interview creel survey. These equations are valid for both the case when all completed trip anglers leaving the fishery were interviewed, and the case when some anglers were missed (note all completed trip anglers in the area and time stratum being sampled were counted). The first step involves the estimation of angler effort:

$\hat{E}_h$ = estimated angler-hours in the h^{th} stratum of the fishery

$$= R_h \, (e_{h\cdot\cdot} \div r_{h\cdot}) \qquad [1]$$

h = subscript denoting stratum (as defined by the combination of seasonal period, access location type, type of fishing day (i.e., weekday or weekend-holiday), and time-of-day [i.e., early versus late day]).

R_h = total number of hours (available for fishing) in the h^{th} stratum

$e_{h\cdot\cdot}$ = total effort in hours expended by anglers interviewed within the h^{th} stratum

$$= \sum_{i=1}^{n_h} \hat{e}_{hi\cdot} \qquad [2]$$

i = subscript denoting period sampled within the h^{th} stratum

n_h = number of samples collected within the h^{th} stratum

$\hat{e}_{hi\cdot}$ = estimated effort for the i^{th} sample within the h^{th} stratum

$$= O_i \bar{e}_{hi\cdot} \qquad [3]$$

O_i = number of anglers counted in the i^{th} sample within the h^{th} stratum (including interviewed anglers and "missed" anglers)

$$= o_i + p_i \qquad [4]$$

o_i = number of anglers interviewed during the i^{th} sample

p_i = number of anglers not interviewed (i.e., "missed") during the i^{th} sample

$\bar{e}_{hi.}$ = the mean effort (in angler-hours) for the i^{th} sample within the h^{th} stratum

$$= \sum_{j=1}^{o_i} (e_{hij}) \div o_i \qquad [5]$$

j = subscript denoting the angler interviewed during the i^{th} period within the h^{th} stratum

e_{hij} = effort (in angler-hours) of the j^{th} angler interviewed in the i^{th} sample in the h^{th} stratum

$r_{h.}$ = total number of hours sampled in the h^{th} stratum

$$= \sum_{i=1}^{n_h} r_{hi} \qquad [6]$$

r_{hi} = hours sampled during the i^{th} sample in the h^{th} stratum

$\hat{V}_h(\hat{E}_h)$ = the variance estimate for the estimate of E_h, obtained by the standard formula for the estimation of the variance of a product of a constant and a variance of a random variable (Lehmann 1975)

$$= R_h^2 \hat{V}(e_{h..} \div r_{h.}) \qquad [7]$$

$\hat{V}(e_{h..} \div r_{h.})$ = the variance estimate for the effort rate (i.e., the ratio of $e_{h..}$ to $r_{h.}$), which is estimated approximately by the standard formula for the variance of the ratio of random variables (see Cochran 1977, section 6.3)

$$\approx \{ (\bar{e}_{h.}) \div (\bar{r}_{h.}) \}^2 \{ (s_e^2 \div (\bar{e}_{h.})^2) + (s_r \div (\bar{r}_{h.})^2) - [(2 \text{ cov}(e,r)) \div (\bar{e}_{h.}\bar{r}_{h.})] \} \qquad [8]$$

$\bar{e}_{h.}$ = mean effort (in angler-hours) for the n_h samples in the h^{th} stratum

$$= e_{h..} \div n_h \qquad [9]$$

$\bar{r}_{h\cdot}$ = mean hours sampled for the n_h samples in the h^{th} stratum

= $r_{h\cdot\cdot} \div n_h$ [10]

s_e^2 = variance estimate associated with estimating the effort component of the effort rate

= $[(R_h - r_h) \div R_h][s^2_{B_e} \div n_h] + [(O_h - o_h) \div (R_h O_h)][s^2_{W_e} \div o_h]$ [11]

$s^2_{B_e}$ = the between sample variance for effort

= $\sum_{i=1}^{n_h} (\bar{e}_{hi} - \bar{e}_{h\cdot\cdot})^2 \div (n_h - 1)$ [12]

O_h = $\sum_{i=1}^{n_h} O_i$ [13]

o_h = $\sum_{i=1}^{n_h} o_i$ [14]

$\bar{e}_{h\cdot\cdot}$ = $e_{h\cdot\cdot} \div o_h$ [15]

$s^2_{W_e}$ = the within sample (between angler) variance for effort

= $[O_i^2 \div o_i] \left[\sum_{j=1}^{o_i} (e_{hij} - \bar{e}_{hi\cdot})^2 \div (o_i - 1)\right]$ [16]

s_r^2 = variance estimate associated with estimating the hours sampled component of the effort rate

= $[(R_h - r_h) \div (R_h n_h)][\sum_{n=1}^{n_h} (r_{hi} - \bar{r}_{h\cdot})^2 \div (n_h - 1)]$ [17]

$\text{cov}(e,r)$ = covariance estimate between the effort and hours sampled components of the effort rate estimate

$$= [(R_h - r_h) \div (R_h n_h)][\sum_{i=1}^{n_h} [(e_{hi}. - \bar{e_h}.)(r_{hi} - r_h.)] \div (n_h - 1)] \quad [18]$$

The final step in estimating the effort for the entire season involves combining the stratum estimates:

$\hat{E}$ = overall estimated effort

$$= \sum_{h=1}^{q} (E_h) \quad [19]$$

q = number of strata

$\hat{V}(E)$ = estimated variance of E, assuming independence of the stratum estimates

$$= \sum_{h=1}^{q} (\hat{V}_h(\hat{E}_h)) \quad [20]$$

Harvest was estimated similarly by substituting the corresponding catch statistics in place of the effort statistics into equations 1-20, above. Harvest was estimated for each of the following species/categories:

Non-clipped steelhead kept
Adipose-clipped steelhead kept
Unknown clip status steelhead kept
All steelhead kept
Non-clipped steelhead released
Adipose-clipped steelhead released
Unknown status steelhead released
All steelhead released
Rainbow trout *Oncorhynchus mykiss* kept
Rainbow trout released
Cutthroat trout *Oncorhynchus clarki* kept
Cutthroat trout released
Dolly Varden *Salevlinus malma* kept
Dolly Varden released

Note, that the approach as presented above, for variance estimation, is valid for a simple stratified random sampling design with only one stage of sample selection. Our use of this approach was not entirely correct, in that selection of the time to sample (within a unique combination of strata definitions) was not a simple random process; and the location to sample within area strata represented a second stage of sampling. Due to the complexities of the sample allocation process and due to the limitations of sampling density, we were not able to estimate the variance for the second stage (i.e., by using squared differences between sample means and means by location [and/or sample period]). However, the use of a single-stage sampling approach was conservative in that the resulting variance estimates were larger than if a multi-stage estimator had been applied.

The contribution of hatchery steelhead trout to the Ward Creek sport fishery listed above (Objective 3) was estimated by using the estimate for the number of adipose-clipped steelhead kept, and the estimate for all steelhead kept.

Mean length and mean weight of steelhead from the sampled harvest were calculated using standard procedures.

All analyses were conducted with the help of an RTS biometrician, who evaluated the necessary assumptions involved with the use of the estimators as described above. Additionally, the RTS biometrician evaluated the development of confidence interval estimates from the estimated variance (if normality applies) or from nonparametric bootstrapping methods (Efron and Gong 1983).

RESULTS

Estimates of Catch and Effort

During the period from 29 February to 19 June 1988, the estimate for the number of steelhead caught and kept was 359 with 95% confidence limits from 193 to 525. The estimate for the number of steelhead caught and released was 971 with 95% confidence limits from 45 to 2,069. Table 1 presents the estimated biweekly number of wild and coded-wire-tagged (CWT) steelhead kept, and the number of wild steelhead released (no CWT steelhead were released). Only nine per cent (32 out of 359) of the estimated number of steelhead caught and kept were hatchery (cwt) fish.

The total estimated effort was 3,819 angler-hours with 95% confidence limits from 2,541 to 5,098. Over 95 per cent of this effort (3,638 angler-hours) was directed toward steelhead, and less than 5 per cent (182 angler-hours) was directed toward other species of trout or char. Table 2 presents the estimated effort for steelhead and for other species by biweekly period. Note that both steelhead catch and steelhead effort peaked during biweekly period 8 (11 April to 24 April 1988).

Table 1. Estimated steelhead catch (kept and released) in Ward Creek by biweekly period, 1988.[1]

Date	Biweekly Period	Wild Steelhead Kept	Wild Steelhead Released	Hatchery (CWT) Steelhead Kept[2]
29 Feb-13 Mar 88	5	13 (1- 38)	0	0
14 Mar-27 Mar 88	6	47 (3-101)	38 (3- 109)	0
28 Mar-10 Apr 88	7	32 (1- 94)	72 (8- 137)	0
11 Apr-24 Apr 88	8	57 (4-117)	544 (18-1,584)	16 (1-47)
25 Apr-08 May 88	9	96 (34-159)	187 (12- 489)	16 (1-47)
09 May-22 May 88	10	50 (3-111)	116 (7- 268)	0
23 May-05 Jun 88	11	0	0	0
06 Jun-19 Jun 88	12	0	0	0

[1] 95% confidence intervals are included in parentheses.

[2] No hatchery (CWT) steelhead were reported as being caught and released.

Table 2. Estimated steelhead effort (angler-hours) in Ward Creek by biweekly period, 1988.[1]

Date	Biweekly Period	Steelhead Hours	Other Hours
29 Feb-13 Mar 88	5	387 (68- 705)	13 (1- 38)
14 Mar-27 Mar 88	6	345 (177- 512)	6 (1- 18)
28 Mar-10 Apr 88	7	337 (22- 680)	0
11 Apr-24 Apr 88	8	1,101 (140-2,062)	16 (1- 47)
25 Apr-08 May 88	9	910 (304-1,517)	0
09 May-22 May 88	10	309 (109- 510)	13 (1- 39)
23 May-05 Jun 88	11	227 (141- 313)	0
06 Jun-19 Jun 88	12	21 (2- 61)	133 (12-265)

[1] 95% confidence intervals are included in parentheses.

Table 3 lists estimates with upper and lower confidence limits for angler-hours, steelhead-hours, salmon-hours, other-target-hours, non-clipped steelhead kept, adipose-clipped steelhead kept, unknown clip status steelhead kept, all steelhead kept, non-clipped steelhead released, adipose-clipped steelhead released, unknown clip status steelhead released, all steelhead released, rainbow trout kept, rainbow trout released, cutthroat trout kept, cutthroat trout released, Dolly Varden kept, and Dolly Varden released for the entire period from 29 February through 19 June 1988.

Distribution of Effort

Fishing areas and the level of fishing pressure (heavy, medium, or light) for each are presented by month in Table 4. An area was classified as heavy if more than five anglers were observed, medium if three to five anglers were observed, and light if less than three anglers were observed. The most consistantly and heavily fished area was Grassy Point, which is located near the inlet on Ward Lake. Eighty-two per cent of the anglers interviewed were Alaska residents, and 18% were non-residents. During the creel survey interviews, anglers were also asked if they used spinners, flies, bait (salmon eggs), or other artificial lures. Responses to this question indicated that 15.4% used spinners, 8.3% used flies, 35.4% used bait, and 40.9% used artificial lures other than spinners or flies.

Standard Age-Weight-Length (AWL) Data

A total of 26 steelhead were examined during the creel survey period. Four of these fish were coded-wire-tagged fish of hatchery origin, and the remaining 22 were wild. Eleven of the fish examined were males, 14 were females, and the sex of one fish was not determined. Lengths ranged from 505 mm to 810 mm and averaged 692 mm (Figure 2). Weights ranged from 3 lbs to 13 lbs and averaged 6.6 lbs (Figure 3). Ages were determined by examining scales collected from each fish, and ages ranged from 3.1 to 4.3 years. Two steelhead were age 3.1, 8 were age 3.2, 8 were age 3.3, 4 were age 4.2, and 4 were age 4.3 (Figure 4). Scale examination also indicated that four of these fish (1 hatchery and 3 wild) were repeat spawners.

Distribution of Spawning Steelhead

The distribution of spawning steelhead in Ward Creek was determined by direct observation. The stream was surveyed on foot about once a week, and the location of steelhead trout was recorded on hand-drawn maps. Table 5 represents the distribution of spawning steelhead with reference to the areas in Figure 1. In general, steelhead appeared to move from the intertidal area through the lower portion of the system and into Ward Lake fairly quickly. Once in the lake, fish appeared to wait for medium to high water levels before moving into the upstream areas to spawn. The major spawning area seemed to be the area from the inlet to the lake upstream to the swinging bridge, with spawning being much more scattered in the remainder of the stream. The largest number of steelhead observed in the stream at one time was 82.

Table 3. Estimated angler effort and catches for Ward Creek, 29 February through 19 June 1988.

	APPROXIMATE[1] 95% C.I. LOWER LIMIT	ESTIMATE	APPROXIMATE 95% C.I. UPPER LIMIT
Angler-hours	2,541	3,819	5,098
Steelhead-hours	2,378	3,638	4,898
Salmon-hours	0	0	0
Other-target-hours	41	182	322
Non-clipped Steelhead Kept	159	296	432
Adipose-clipped Steelhead Kept	2	32	76
Unknown clip status Steelhead Kept	2	31	75
All Steelhead Kept	193	359	525
Non-clipped Steelhead Released	44	957	2,055
Adipose-clipped Steelhead Released	0	0	0
Unknown clip status Steelhead Released	1	14	41
All Steelhead Released	45	971	2,069
Rainbow Trout Kept	0	0	0
Rainbow Trout Released	1	11	33
Cutthroat Trout Kept	0	0	0
Cutthroat Trout Released	15	171	431
Dolly Varden Kept	0	0	0
Dolly Varden Released	13	191	457

[1] refer to equation [8].

Table 4. Distribution of fishing effort on Ward Creek, March through June, 1988.

Month	Area[1]	Number of Heavily Fished[2] Pools	Number of Moderately Fished[3] Pools	Number of Lightly Fished[4] Pools	Total
March	5	0	0	0	0
	4	0	0	1	1
	3	1	3	0	4
	2	3	1	0	4
	1	0	1	0	1
April	5	0	0	1	1
	4	0	0	2	2
	3	9	2	0	11
	2	4	0	0	4
	1	0	1	0	1
May	5	0	0	2	2
	4	0	0	4	4
	3	6	4	0	10
	2	3	0	0	3
	1	0	1	0	1
June	5	0	0	0	0
	4	0	0	0	0
	3	0	1	2	3
	2	0	2	0	2
	1	0	1	0	1

[1] Areas 1 through 5 are identified in Figure 1.
[2] More than five anglers observed.
[3] Three to five anglers observed.
[4] Less than three anglers observed.

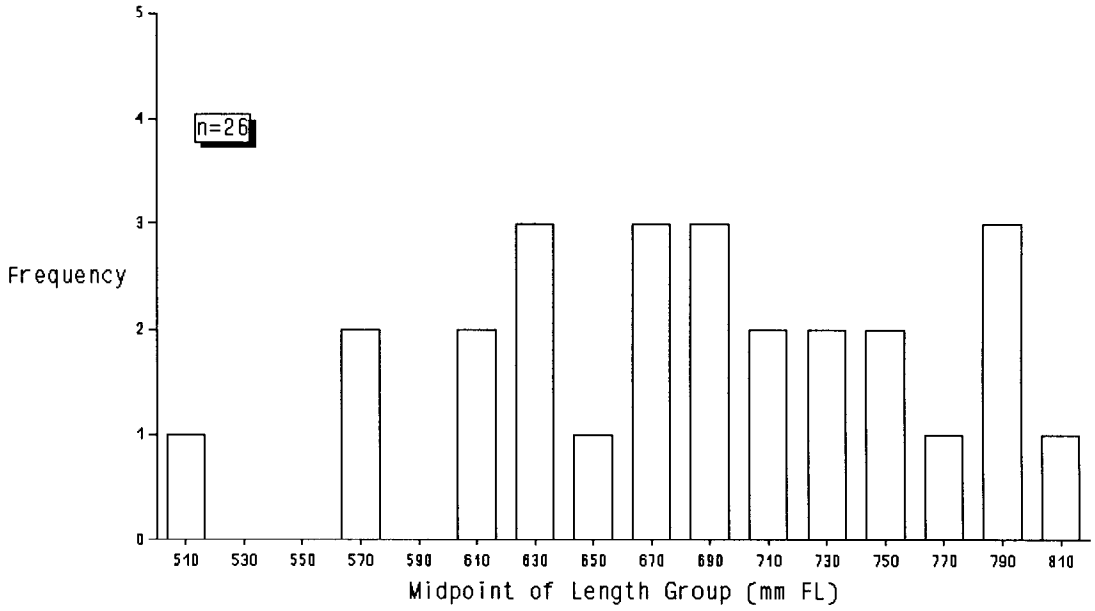

Figure 2. Length frequency distribution of steelhead sampled from Ward Creek, 1988.

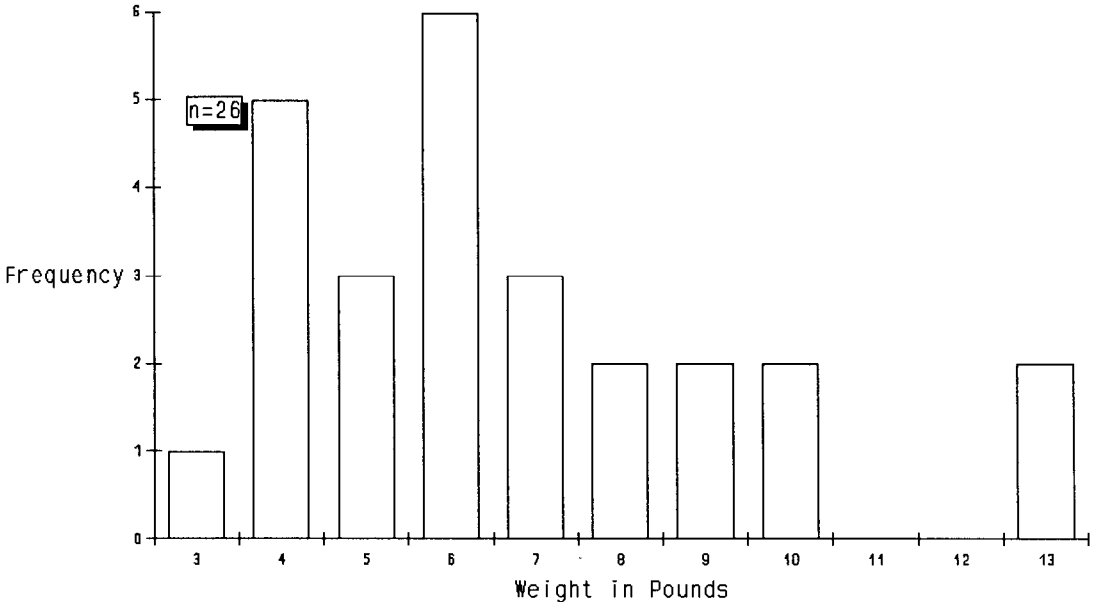

Figure 3. Weight frequency distribution of steelhead sampled from Ward Creek, 1988.

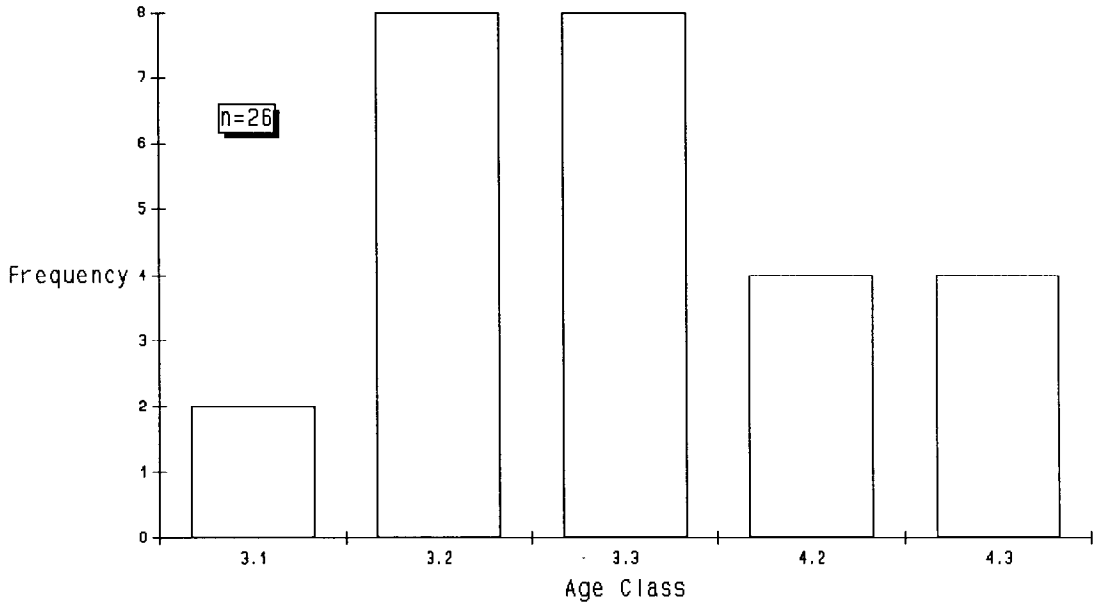

Figure 4. Age frequency distribution of steelhead sampled from Ward Creek, 1988.

Table 5. Distribution of spawning steelhead in Ward Creek, April through June, 1988.

Date	Area[1]	Number of Spawners Observed	Comments
4/12/88	5	0	water level high, but dropping,
	4	0	visibility fair
	3	35	
	2	0	
	1	0	
4/24/88	5	0	water level low, visibility good
	4	0	
	3	10	
	2	0	
	1	0	
4/29/88	5	0	visibility fair
	4	0	
	3	50	
	2	0	
	1	0	
5/2/88	5	0	water level medium and dropping,
	4	0	visibility good except at lake
	3	18	
	2	25	
	1	0	
5/6/88	5	0	water level low, visibility good
	4	5	
	3	3	
	2	0	
	1	0	
5/7/88	5	0	
	4	0	
	3	17	
	2	30	
	1	0	

-continued-

Table 5. (continued)

Date	Area[1]	Number of Spawners Observed	Comments
5/12/88	5	3	water level low and rising, visibility fair
	4	3	
	3	12	
	2	4	
	1	0	
5/18/88	5	0	water level low, visibility good
	4	35	
	3	17	
	2	4	
	1	20	
5/27/88	5	0	water level high, visibility poor
	4	0	
	3	29	
	2	0	
	1	0	
6/12/88	5	0	water level low, visibility good
	4	0	
	3	6	
	2	1	
	1	19	

[1] Areas 1 through 5 are identified in Figure 1.

DISCUSSION

The Ward Creek steelhead fishery provides recreational fishing primarily for local anglers during late winter and early spring. Information from the statewide harvest survey (Mills 1987) indicates that the estimated harvest of steelhead trout has varied from 94 to 547 fish from 1982 through 1987, and has averaged 296 fish during the same period. This year's estimated harvest of 359 steelhead does not seem to indicate any major changes in overall status of the steelhead harvest in the Ward Creek system (Figure 5).

Efforts directed toward enhancing the steelhead run by stocking smolts from the Klawock hatchery on Prince of Wales Island (30,000 in 1984, 28,553 in 1985, 28,687 in 1986, and 20,000 in 1987) have apparently not been very successful as indicated by the low number of adipose-clipped steelhead trout estimated to have been harvested (32 clipped fish out of a total harvest of 359). There is a possibility that returning hatchery fish entered the system before angler interviews began (i.e. before 29 February 1988).

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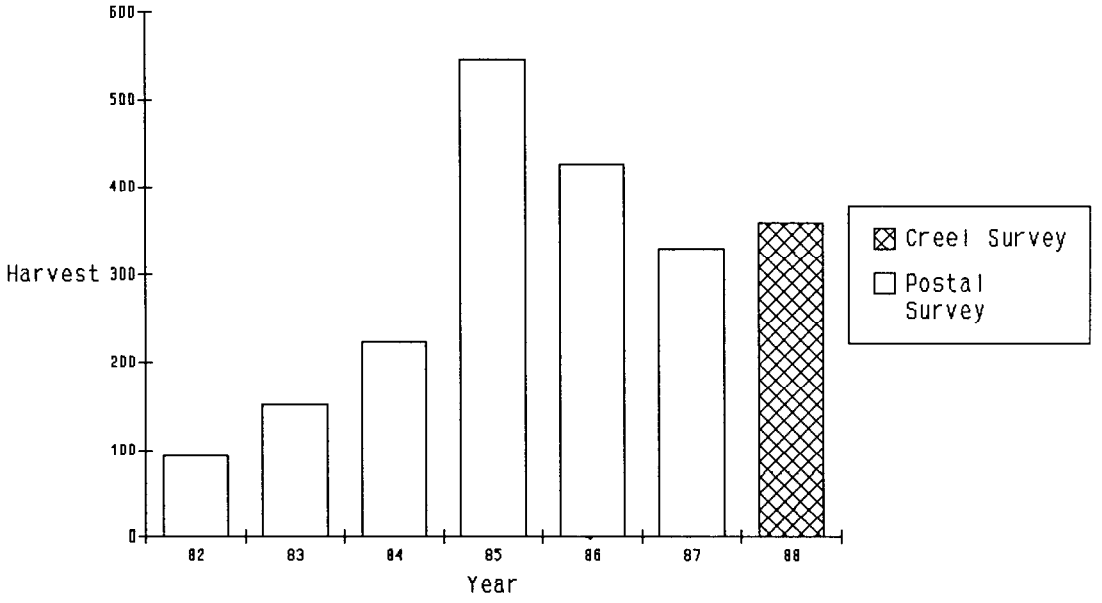

Figure 5. Estimated harvest of steelhead in Ward Creek, 1982-88.